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Experimental Design for Ozone Projects

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(Debbie Carlisle and Steve Schneider)
(Following the 4 Question Approach – by Cothron, Giese, Rezba, referenced by the NRC, 2000)

Note: Read through this handout with your group BEFORE you begin to answer Part 1. Part 1 is your goal and the 4 questions below will help you design your experiment.

Part 1: The Experiment
A. Consider the available materials and discuss with your group members what you would like to explore with the ozone strips.
Develop a Testable question for your group:
Testable Question:_____

B. The Four Questions: Answer the four questions below in collaboration with your group members (REFER to Example in Table 2 below). Keep in mind that you need to control some variables to maximize the reliability of your data.

1. What Materials do you need?

2. What do you want to observe?

3. What is to be modified?

4. How will you measure the change?

Table 2. Completed four question strategy

National Research Council. (2000). *Inquiry and the National Science Education Standards*. Washington, D.C.: National Academy Press. (p. 29).

Testable question: How does the number of ice cubes affect temperature of water?

1. Materials available:
   Number of ice cubes, thermometer, shape of ice cube, amount of water, initial water temperature, type of water, stir, container, graduated cylinder

2. Different forms of materials:

Number ice cubes	Thermometer	Shape of ice cube
0	°C	Rectangle
1	°F	Circle
2		Crushed
3		Half moon
4		Square
		Cylinder

Amount of water	Initital temperature water	Time
50ml	10°	1 minute
100ml	15°	2 minutes
150ml	20°	3 minutes
200ml	25°	

Type of water	Stir	Container	Graduated cylinder
tap	yes	glass	10ml
distilled	no	plastic	25ml
bottled		metal	50ml
		styrofoam	100ml

3. What is to be modified?
   Number of ice cubes

4. How will its impact be measured?
   °C

(From www.scirp.org/journal/ce ; ISSN:2151-4755)

Part 2: Helpful Tips and Examples

Carefully define your problem. What environmental conditions will you test? Indoors or outdoors? Sunlight or no sunlight? Etc.

Consider these example questions:

- How do my test strips react to UV light? Direct sunlight, etc.
- Do wind patterns and air flow affect ozone readings?
- Which test strip provides more accurate readings under _____ conditions?
- Does ozone gas, O_3, have to be present for the strip to change color?
- EcoBadge strips have been reported to yield results that are falsely high. Do your results corroborate this finding?
- Own idea ?

Lastly, can you identify any factors related to camera use that could affect the reliability of your results? Did you control for any of these?

Part 3: Collecting Data

A. Design a data table for your measurements and gather your data

B. What things need to be held constant? Why?

Part 4: Plenary Session (Wrap – up)

Each small group reports back to the full cohort about their findings, this way everyone can share their experience. Each group will have approximately 5 minutes to share their experimental findings.